

Listing of Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Claims **1-33**.(canceled)

34. (Currently Amended) A semiconductor wafer processing system having a vacuum environment therein and comprising:

a semiconductor wafer processing module that includes vacuum chamber having an upwardly facing wafer holder therein configured to hold a semiconductor wafer for processing in the vacuum environment;

at least one annular maintenance item in the processing module in the vacuum environment, the at least one annular maintenance item including a ring, a shield, an insulator, an adapter, a baffle, ~~a plate~~ or ~~another~~ annular internal chamber component of a type that may be removed for cleaning or maintenance, or to be replaced, the at least one annular maintenance item having an outside dimension that is larger than a semiconductor wafer being held for processing on the wafer holder;

the processing module also having mounting structure therein configured to removably mount a the annular maintenance item in the vacuum environment in the chamber of the processing module centered on a vertical axis with the wafer holder;

the annular maintenance item being removably mounted on the mounting structure;

a transfer system including a port larger than the at least one annular maintenance item and a transfer module with the vacuum environment therein communicating through the port with the vacuum environment in the processing module, the transfer module having a wafer transfer mechanism therein operable to transfer a semiconductor wafer within the vacuum environment between the transfer system and the processing module;

the transfer mechanism including a transfer arm extendable from the transfer system through the port and into the processing module, the transfer arm having thereon an end effector having at least one

upwardly facing surface configured for supporting a semiconductor wafer thereon by gravity and additionally configured for supporting the maintenance item thereon for transfer;

the mounting structure including a presenting mechanism configured to move the annular maintenance item, while remaining centered on the vertical axis, from a processing position in which it is used during processing to a position for pick up by the transfer mechanism;

a controller coupled to the processing module and the transfer system and programmed to control the wafer transfer mechanism to transfer a semiconductor wafer to and from the wafer holder in the vacuum chamber of the processing module and through the transfer system; and

the controller also being programmed to control the wafer transfer mechanism to transfer the annular maintenance item to and from the ~~mounting structure~~ position for pick up in the vacuum chamber of the processing module and to and from the transfer ~~system-module with the annular maintenance item supported by gravity on an upwardly facing surface of the end effector~~ without exposing the processing module to an outside environment.

35. (Currently Amended) The processing system as claimed in claim 34, further comprising:

a maintenance system comprising a storage assembly having a vacuum environment therein and configured to store ~~the~~ at least one annular maintenance item therein and an exchange system operable to transfer a ~~the at least one annular maintenance item~~ within a vacuum environment between the transfer system and the maintenance system without exposing the vacuum environment to an outside environment.

36. (Currently Amended) The processing system as claimed in claim 35, further comprising:

an isolation assembly that includes a gate valve assembly and is coupled between the maintenance system and the transfer system, the isolation assembly being operable to selectively open to communicate the environment within the maintenance system with the vacuum environment within the transfer system.

37. (Currently Amended) The processing system as claimed in claim **35**, wherein the exchange system comprises:

a drive system, at least one transfer arm coupled to the drive system having an end effector thereon; and

the controller being programmed to control the drive system to move the at least one transfer arm and end effector to transfer the at least one annular maintenance item between the maintenance system and the processing module and to transfer the wafer between the transfer system and the wafer holder in the vacuum chamber of the processing module.

38. (Currently Amended) The processing system as claimed in claim **35**, wherein:

~~the maintenance system includes a storage assembly;~~

the exchange system includes a drive system, at least one transfer arm coupled having an end effector thereon and coupled to the drive system; and

the controller is programmed to control the drive system to move the at least one transfer arm and end effector to transfer the maintenance item between the transfer system and the storage assembly in the maintenance system.

39. (Currently Amended) The processing system of claim **34** wherein the processing module is an etching module and the wafer holder is upwardly facing in the vacuum chamber thereof, and wherein:

the at least one annular maintenance item is an annular ~~member~~-focus ring having an outside diameter larger than that of the semiconductor wafer, the focus ring being in a mounting position in the etching module centered on the vertical axis and surrounding a wafer support area of the wafer holder where the annular focus ring maintenance item is prone to being etched by an etching process performed on a wafer on the wafer holder; and

the annular focus ring maintenance item is removable from the processing module in part by a lifting of the annular focus ring maintenance item with the presenting mechanism from the mounting position to the position for pick up.

40. (Currently Amended) The processing system of claim **34** wherein the processing module is a deposition module having a downwardly facing deposition material source centered on the vertical axis above the wafer holder, and the wafer holder is upwardly facing in the vacuum chamber thereof, and wherein:

the at least one annular maintenance item is an annular ~~member~~ deposition shield having an outside dimension larger than that of the semiconductor wafer, the annular deposition shield being in a mounting position in the etching-deposition module surrounding a wafer support area of the wafer holder where the annular deposition shield ~~maintenance item~~ is prone to collecting deposits of material thereon when a deposition process is performed on a wafer on the wafer holder;

the mounting structure is mounted to and extends downwardly from the deposition material source; and

the annular deposition shield ~~maintenance item~~ is mounted in its mounting position in the deposition module so as to be removable from the processing module in part by a lifting of vertically moving the maintenance item with the presenting mechanism from the mounting position to the position for pick up.

41. (Currently Amended) The processing system of claim **34** wherein:

the ~~mounting structure~~ presenting mechanism includes a lifting mechanism configured to move the at least one annular maintenance item from a mounting position in which it is used during processing to a position for pick up by the transfer mechanism.

42. (Currently Amended) The processing system of claim **41-40** wherein:

~~the maintenance item is an annular ring configured to surround a wafer on a wafer support;~~

the mounting structure includes a set of lift pins in the wafer support operable to lift the ring annular deposition shield into position for pick up by a wafer transfer arm.

43. (Currently Amended) The processing system of claim **41** wherein:

the at least one annular maintenance item is supported within the processing module from the top of the processing module;

the mounting structure includes a set of elements operable to releaseably hold the at least one annular maintenance item and to lower the at least one annular maintenance item into a position for pick up by a wafer transfer arm.

44. (Currently Amended) The processing system of claim ~~41~~**34** wherein:

the transfer mechanism includes a wafer transfer arm ~~more particularly~~ configured to pick up a wafer and a separate transfer arm more particularly configured to pick up a the at least one annular maintenance item.

45. (Previously Presented) The processing system as claimed in claim **34**, wherein the processing module is at least one of an ALD module, a deposition module, a coating module, a patterning module, a developing module, a metrology module, a thermal processing module, and a cleaning module.

46. (Currently Amended) A method of operating a semiconductor wafer vacuum processing system that includes a wafer processing module that is coupled to a transfer system having an interior with a vacuum environment therein, to replace expendable or serviceable components from within a processing module of the system, the method comprising:

performing a vacuum process on a wafer supported in a vacuum environment in a vacuum chamber of the processing module;

operating the transfer system by moving a wafer transfer arm thereof into or from the processing module to move a semiconductor wafer to or from the processing module;

monitoring a processing recipe for the processing module with a controller, and, in response to the monitoring, determining with the controller when to pick up and remove a maintenance item from the processing module for maintenance;

presenting a maintenance item that is an internal component of the processing module in a position for pick up by a transfer arm of the transfer system; and

further operating the transfer system by moving a wafer transfer arm thereof into the processing module and picking up the maintenance item from the position for pick up therewith and removing the picked up maintenance item from the processing module without exposing the interior of the processing module to an outside environment;

the presenting of the maintenance item and the further operating of the transfer system being performed in response to the determination.

47. (Previously Presented) The method of claim **46** wherein:

the performing of the vacuum process on the wafer includes etching the wafer in the vacuum environment in the vacuum chamber while exposing the maintenance item to an etching process when it is in a mounting position in the vacuum chamber.

48. (Currently Amended) The method of claim **46** wherein:

the performing of the vacuum process on the wafer includes depositing material on the wafer in the vacuum environment in the vacuum chamber while exposing the maintenance item to a depositing of material thereon when the maintenance item ~~it~~ is in a mounting position in the vacuum chamber.

49.(Previously Presented) The method of claim **46** wherein:

the presenting of the maintenance item includes lifting the maintenance item from a mounting position in the vacuum chamber.

50. (Previously Presented) The method of operating a processing system as claimed in claim **46**, the method further comprising:

operating the transfer system by moving a wafer transfer arm thereof to transfer a second maintenance item from a maintenance system that is coupled to the transfer system without exposing the interior of the processing module to an outside environment; and

removably mounting the transferred second maintenance item inside of the processing module.

51. (Canceled)

52. (New) The system of claim **34** wherein:

the controller is programmed to monitor a processing recipe for the processing module and to determine from the monitoring when to exchange a first maintenance item with a second maintenance item, and to control the presenting of the maintenance item and the further operating of the transfer system in response to the determination.

53. (New) The system of claim **35** wherein:

the controller is programmed to monitor a processing recipe for the processing module and to determine from the monitoring when to exchange a first maintenance item with a second maintenance item, and to control the presenting of the maintenance item and the further operating of the transfer system in response to the determination.

54. (New) The system of claim **39** wherein:

the controller is programmed to monitor a processing recipe for the processing module and to determine from the monitoring when to exchange a first maintenance item with a second maintenance item, and to control the presenting of the maintenance item and the further operating of the transfer system in response to the determination.

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55. (New) The system of claim **40** wherein:

the controller is programmed to monitor a processing recipe for the processing module and to determine from the monitoring when to exchange a first maintenance item with a second maintenance item, and to control the presenting of the maintenance item and the further operating of the transfer system in response to the determination.